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Features
Summer 2000 Volume II, Issue 2

Lab's technology safeguards spacecraft

by John Brownlee, Space Vehicles Directorate

KIRTLAND AFB, N.M. — No rabbit's foot, four-leaf clover, or ancient incantation can protect the Tri-Service Experiments Mission-5 (TSX-5) spacecraft launched June 7 at Vandenberg AFB, Calif. from the potential mission-busting dangers found in space.

But solid, painstakingly developed technologies hammered out here by the Air Force Research Laboratory Space Vehicles Directorate will. That's one of its jobs — to preserve and protect delicate components from what is often an unforgiving environment, both inside and outside of a spacecraft.

Onboard TSX-5 are the latest advanced Air Force protection devices that guard sensitive spacecraft against possible calamities such as unwanted vibrations and space-based radiation.

"Vibrations are normally generated by the routine internal workings of some satellite subsystems, such as the operation of a cryocooler," said Dr. Scott Erwin, an aerospace engineer with AFRL's Space Vehicles Directorate.

A cryocooler is a refrigeration device that lowers the temperature of infrared cameras and sensors to heighten their sensitivity to very distant sources of heat such as the exhaust gases of a "boosting" missile or other earth- or space-based heat-producing object.

"Vibrational disturbances can ruin spacecraft surveillance missions by shaking sensitive cameras or sensors enough to cause blurred images. And when successful military missions depend on stable, virtually immovable cameras and sensors, those instruments must somehow be isolated from vibrations. That's where we come in," Erwin said.

"Onboard today's TSX-5 flight, for instance, we have a medium-wave infrared camera that, when fixed to a stable mount, captures very sharp images," Erwin said. "But this camera requires a cryocooler, and to control the cooler's unwanted motion, we use a Vibration Isolation Suppression System (VISS) that we developed here."

In part, VISS works like shock absorbers on a car, dampening unwanted movement and preventing the camera from shaking and producing unusable pictures. The system counteracts motion to reduce by a factor of 30 the magnitude of vibrations, sufficient to isolate sensitive equipment that demands near-absolute stability.

"We have had a lot of success with this technology and expect to rely on it in the future," Erwin said.
Outside the spacecraft lurks a danger of another kind — cosmic radiation. "Our Compact Environmental Anomaly Sensor (CEASE), also onboard TSX-5, will monitor the near-earth environment around a spacecraft and warn us about naturally occurring space environmental hazards," said AFRL space weather researcher Kevin Ray.

Because of CEASE-based alerts, spacecraft operators on the ground will now be able to use the information to identify and understand anomalies such as electrical charging, single event upsets, and radiation-dose effects—potentially harmful to sensitive spacecraft electronics — and take the necessary action to preserve the mission. Radiation can overload microcircuits and cause their transistors to shut down — permanently. And dead transistors mean dead spacecraft.

"Ultimately, CEASE, which is about the size of a grapefruit, lightweight, and uses little power, enhances the safety, reliability, and long-term performance of operational spacecraft," Ray said.
CEASE, which can detect man-made forms of nuclear radiation, is also scheduled for launch on the British Defence Evaluation and Research Agency's Space Technology Research Vehicle this year as well as the Defense Support Program's spacecraft in early 2001.

TSX-5 relies on a unique advanced composite bus structure built under an AFRL contract by Boeing Space and Defense. In addition to being of an innovative one-piece construction designed to be extremely

lightweight with few parts, the structure was fabricated using the latest materials that easily transfer heat from any one section of the spacecraft to another.

TSX-5 will operate AFRL's experimental payloads for at least six months with a one-year goal. **@**